Towards Quality of Sensory Experience in Multimedia

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***Abstract*—This paper discusses how user-centric multimodal and multimedia systems impact the quality of experience and how the latter can be assessed (*Abstract*)**

Keywords—quality of experience, multimodal, multisensory, quality of life

I. INTRODUCTION

In communications systems, the term quality is often easy to understand but difficult to define. The COST Action IC 1003 QUALINET (http://www.qualinet.eu/) defines quality as "the outcome of an individual's comparison and judgment process. It includes perception, reflection about the perception, and the description of the outcome." In this paper, we discuss various aspects of Quality of Experience in a Multimedia and Sensory Experience environment, provide illustrative examples, and highlight open issues as well as challenges.

II. QUALITY OF EXPERIENCE

COST Action IC1003 QUALINET defines Quality of Experience (QoE) as "the degree of delight or annoyance of the user of an application or service. It results from the fulfillment of his or her expectations with respect to the utility and/or enjoyment of the application or service in the light of the user's personality and current state" [1, 2].
In other words, QoE is all about the user who's to experience something (a service, application, product, etc.) within a given context, and it is determined by various factors both technical as well as social and psychological as detailed in [3].
In most communications systems, modalities and therefore their QoE assessment is limited to two human senses, namely hearing and seeing, but as we all know, more senses may impact the quality of an experience.

III. QUALITY OF SENSORY EXPERIENCE

The consumption of any content, specifically multimedia content, may stimulate also other senses than vision or hearing, i.e., olfaction, mechanoreception, thermoception, and so on, including also perceptions and emotions [4]. This requires the annotation of content with additional (meta-)data providing the so-called sensory effects to appropriately steer the devices capable of rendering these effects. The aim is to give users the sensation of being part of particular media resulting in a worthwhile, informative user experience which is referred to as sensory experience. In the literature, this new type of content encompassing multiple sensorial modalities is referred to as mulsemedia which is a portmanteau built from multiple sensorial media (or multi-sensory media) [5].

IV. ILLUSTRATIVE EXAMPLE OF QOE

An example of assessment of QoE is in the prediction of olfactory experience from sensory signals. In a study carried out at EPFL, subjects were exposed to different odors while their brain activities (EEG) were recorded. The resulting sensory signals were then analyzed to predict the Quality of Experience defined as the level of pleasant or unpleasant odor perceived by subjects (Figure. 1).
To achieve this, a novel neuronal model called functional connectivity map was used for the analysis of the sensory signals. Machine learning (Support Vector Machine) was further employed to classify the level of Quality of olfactory Experience.
This approach has shown Quality of Experience prediction results with up to 65% accuracy when compared to a ground truth obtained from a questionnaire.

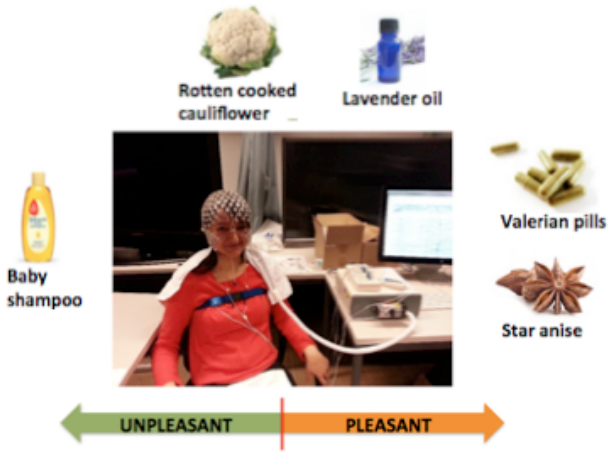

Fig. 1. An example of assessment of olfaction QoE by using EEG signals

V. QUALITY OF LIFE

Quality of Life (QoL) is a relatively old concept dating back to the eighteen century, mainly thanks to work by Francis Hutcheson who was among the first to explore it in a rigorous and scientific way, defining it as the general well-being of individuals and societies. QoL has turned out to be of practical use in a wide range of fields as diverse as in international development, healthcare, politics, and employment [6], including approaches toward social life networks as introduced in [7].

A modern concept of QoL can be defined in the intersection between three trends (Personal well-bing/ Personal health, New media experience and Big data/ social media). Unfortunately, currently there is not sufficient awareness and synergy between actors and players in these trends.

New media experiences: refering to better and new representations of multimedia information and content in the context of new systems and applications. Examples include 3D audiovisual content and interfaces, ultra high-definition, high dynamic range and high frame rate video, plenoptic and holographic visual information, mobile, augmented, and immersive multimedia which will not only include haptic devices, but also can extend to olfactory (odor) devices (e.g., oPhone). These advances together with intelligent interfaces and efficient content management will increase the Quality of Experience by providing a superior sense of presence and immersion as described earlier in the Quality of Sensory Experience (QuaSE).

Personal well-being and personal health: relying on an increased popularity of affordable and accessible wearable devices that can sense user's movements, and capture their physiological signals, such as smart watches and health bands, information and communication technologies can help users in the better understanding of themselves and exploit it to improve their well-being, fitness performance and health. Many of such technologies can also be used to sense user's satisfaction and Quality of Sensory Experience, as several recent research results have shown.

Big data and social media: exploiting growth in the number of sensing devices that can understand and gather data from users, as well as their environments, and with the help of data mining and big data analytics, make it possible to extract context information, and use it in specific recommendations and decisions addressed to users. Social networks further allow users to share information and experiences, as witnessed by a number of existing products and services, but also can be used as powerful engines to extract more, better, and richer contexts.

VI. OPEN ISSUES AND CHALLENGES

There are many open issues and challenges in both quality of sensory experience and quality of life as described above.

An important aspect is security and privacy of the data gathered given the fact that an increasing number of sensors (e.g., within smart phones, smart watches, wristbands, etc.) are capturing the user's context which could allow for much more accurate user profiling and personalization – if connected with other data sources and shared with each other.

In todays communication systems users are experiencing a transition from passive consumers to active contributors/producers of content shared within their private/public social networks. The term prosumer has been proposed in the past merging producers and consumers of content which may have different quality aspects when considered in a social context. Additionally, the user's intention when producing content (e.g. taking a picture or video) can be quite diverging and resulting in different requirements for computing and communication systems. For example, some bad quality video taken with the intention to be shared on social networks can easily reach a high number of views if the context is timely and appropriate for a given user community).

Finally, the Quality of Experience, Sensory Experience, and Life are by their nature interdisciplinary, and therefore require research and expertise from various fields including (but not limited to) arts, medicine, psychology, social sciences, technology, etc.

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